WEEKS
COLLECTION

JOURNAL

OF THE

Elisha Mitchell Scientific Society,

1892

NINTH YEAR. SECOND PART.

JOURNAL

OF THE

ELISHA MITCHELL SCIENTIFIC SOCIETY,

VOLUME IX—PART SECOND.

JULY—DECEMBER.

1892.

POST-OFFICE:

CHAPEL HILL, N. C.

E. M. UZZELL, STEAM PRINTER AND BINDER,
RALEIGH, N. C.
1892.

OFFICERS.

1892.

PRESIDENT:

JOSEPH A. HOLMES, - - - - - - - - Chapel Hill, N. C.

FIRST VICE-PRESIDENT:

W. L. POTEAT, - - - - - - - - - Wake Forest, N. C.

SECOND VICE-PRESIDENT:

W. A. WITHERS, - - - - - - - - - Raleigh, N. C.

THIRD VICE-PRESIDENT:

J. W. GORE, - - - - - - - - - - Chapel Hill, N. C.

SECRETARY AND TREASURER:

F. P. VENABLE, - - - - - - - - - Chapel Hill, N. C.

LIBRARY AND PLACE OF MEETING:

CHAPEL HILL, N. C.

TABLE OF CONTENTS.

PAGE.

Statistics of the Mineral Products of North Carolina for 1892. H. B. C. Nitze 55

Additions to the Breeding Avi-fauna in North Carolina Since the Publication of Prof. G. F. Atkinson's Catalogue in 1887. J. W. P. Smithwick 61

An Example of River Adjustment. Charles Baskerville and R. H. Mitchell 64

Character and Distribution of Road Materials. J. A. Holmes 66

To Set Slope Stakes when the Surface is Steep but Slopes Uniformly. J. M. Bandy 82

On the Development and a Supposed New Method of Reproduction in the Sun-animalcule, *Actinosphærium Eichhornii*. John M. Stedman 83

Some Fungi of Blowing Rock, N. C. George F. Atkinson and Hermann Schrenk 95

Record of Meetings 107

Report of Treasurer 108

JOURNAL

OF THE

Elisha Mitchell Scientific Society.

STATISTICS OF THE MINERAL PRODUCTS OF NORTH CAROLINA FOR 1892.

BY H. B. C. NITZE.

The difficulties attending the collection of exact statistics of the various mineral productions are very great, often insurmountable; and especially difficult to obtain are those of the gold, corundum and mica mines, which form the greater part of North Carolina's mining industry.

The following statistics have been collected from the most reliable sources available, under the direction of the *North Carolina Geological Survey*, and although often lacking in detail they will serve to show very nearly what the mineral production of the State has been for the past year.

Of the metallic products gold and iron stand alone. Under the list of non-metallic products we have iron ore, copper ore, bituminous coal, corundum, mica, talc and kaolin.

GOLD.

During 1892 there were fifty-six gold mines, distributed over eighteen different counties, in operation in the State. Of these, fifteen were placer and forty-one vein workings.

The total number of stamps in operation is estimated at 310, the total amount of labor at 500 men, and the total production at $65,000.

PIG IRON.

There was but one blast furnace in active operation in the State, namely, that at Cranberry, Mitchell county, belonging to the *Cranberry Iron and Coal Company*. This is a small brick stack of the following dimensions: Height 50 feet, diameter of bosh 10 feet 2 inches, diameter of hearth 3 feet, capacity 14 to 15 tons per day. It uses the low phosphorus magnetic ore of the Cranberry mine situated close by, magnesian limestone from Carter county, Tenn., and coke from Pocahontas, W. Va.

The total output of this furnace for 1892 was 2,902 gross tons, of which 313 tons were charcoal and 2,589 tons coke iron; the total product was valued at $52,000 at the furnace.

The quality of this product was a special Bessemer iron, averaging less than 1.00 per cent. silicon, and less than 0.025 per cent. phosphorus. It was shipped to steel works in Ohio and Pennsylvania.

The total production in gross tons (22,401 pounds) of the Cranberry furnace for the past nine years is shown in the following table:

1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
388	1,598	1,964	3,250	2,143	2,587	2,840	3,217	2,902

FORGE IRON.

The small amount of forge iron made for purely local purposes at Pasley's forge, in Ashe county, is rather of historical than commercial interest. This forge is situated at the mouth of Helton Creek, and consists of one fire

blown by the water trompe, and one hammer operated by water-power. It is the only forge now in operation in the State, and makes annually about twenty to thirty tons of bar iron for local uses.

IRON ORE.

The total production of iron ore during 1892 is estimated at 23,433 gross tons, valued at $43,306.20 at the mines. Of this amount 17,088 gross tons, valued at $34,423.20, were shipped out of the State; the balance was turned into 2,902 gross tons of pig metal.

The only two mines in operation were the Cranberry mine in Mitchell and the Ormond mine in Gaston county.

The Cranberry Mine, operated by the Cranberry Iron and Coal Company, produced 18,433 gross tons, valued at $25,806.20 at the mines. Of this amount 12,088 tons, valued at $16,923.20, were shipped to furnaces in Southwest Virginia.

The ore is a magnetite, of which the following analysis by Mr. Porter W. Shimer shows the quality of the run of mine:

	Per Cent.
Silica	23.73
Metallic iron	45.90
Metallic maganese	0.44
Alumina	1.01
Lime	9.69
Magnesia	1.51
Sulphur	0.012
Phosphorus	0.007

The total output of the Cranberry mine in gross tons for the past nine years is shown in the following table:

1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.	1892.
3,998	17,839	24,106	45,032	15,705	19,819	30,290	27,628	18,433

The Ormond Mine, situated in Gaston county, on the Charlotte & Atlanta Air Line, produced during 1892 about 5,000 tons of ore, valued at $17,500 at the mines. It was shipped to Birmingham, Ala., and Richmond, Va., for the fettling of puddling furnaces.

The ore is a mixture of hard, block hematite, or rather turgite, porous limonite, and soft, black, powder ore, slightly magnetic, of which the following are some representative analyses:

	I.	II.	III.	IV.
Silica	9.72	1.51		1.55
Metallic iron	52.39	65.79	47.10	65.35
Phosphorus	0.079	0.028	0.057	0.007

I. Lump ore; analysis by N. C. Geological Survey.
II. Lump ore; analysis by Carnegie Bros. & Co., Pittsburg, Pa.
III. Limonite; analysis by C. D. Lawton.
IV. Black powder ore; analysis by Carnegie Bros. & Co.

The mine was closed down in September, 1892, on coming into possession of the *Bessemer Mining Company*, which is remodeling the plant and making preparations for a large output in the near future.

The North Carolina Steel and Iron Company completed their furnace at Greensboro in June, 1892. The height of the stack is 70 feet, diameter of bosh 16 feet, and the calculated capacity 100 tons per day. The plant is fully equipped with all modern improvements, and, together with ore lands, town-site lands and other improvements, represents a total investment so far of $305,000. It is now expected to have this furnace in operation by the coming spring, the delay of putting it in blast having been caused by a deficiency of the necessary funds; and the present low price of iron has deterred the company from endeavoring to procure the requisite capital sooner. It is also proposed to erect a merchant mill, machine shops, foundry and car works during this year, the latter to have a capacity of ten (10) freight cars a day. The principal

supply of ore will be obtained from the mines of the company at Ore Hill, Chatham county, about forty miles distant. This ore is a brown hematite of very fair quality, as shown by the following analyses, made in the laboratory of the *North Carolina Geological Survey:*

	I.	II.	III.	IV.
Silica	4.73	2.35	17.32	3.71
Metallic iron	47.87	47.23	42.88	49.79
Sulphur	0.034	0.280	0.230	0.170
Phosphorus	0.069	0.139	0.106	0.038

These deposits have been partially developed during the past year and about 700 tons of ore taken out. Besides this source magnetic ores from the western part of the State will be used. Limestone will be obtained from Virginia and coke from the Flat Top region in the same State.

In *Granville county* some recently discovered deposits of magnetic iron ore of good quality have been prospected with encouraging results, but no regular mining operations have yet been started, and no ore has been shipped.

COPPER ORE.

The Blue Wing Mine in Granville county was the only producing mine in the State during 1892. Up to October, when the mine and concentrator closed down indefinitely, the production of concentrates, shipped to the Orford Copper Works, N. Y., was valued at $15,000 (estimated).

The ore is chiefly bornite in a quartz gangue. The following analyses show the quality of the ore and concentrates:

	Copper. Per Cent.	Silver. Oz. Per Ton.
Run of mine ore	8.66	3.55
Cobbed ore	14.21	5.66
Jig concentrates	52.32	12.00
Frue vanner concentrates	36.87	12.60

COAL.

The *Egypt Coal Company*, operating the Egypt mine in Chatham county, shipped during 1892 6,500 tons of bituminous coal, valued at $7,475. Misfortunes by fire and water cut down the output to nearly one-half of what it was the year preceding. The company has been engaged in improving and increasing its plant during the past year by the addition of three pumps underground and further hoisting capacity. A second shaft, 8 by 12 feet, is being put down, to be used exclusively for ventilating purposes.

The following analysis by the *North Carolina Geological Survey* represents the quality of this coal:

Moisture	1.25
Volatile matter	33.35
Fixed carbon	49.18
Ash	16.22
Sulphur	1.72
Specific gravity	1.294

CORUNDUM.

The total corundum product for 1892 is estimated at 560 net tons. No estimate of the value can be made.

The chief producers were the Corundum Hill and Ellijay mines in Macon, and the Hogback mines in Jackson county. In Iredell county some private prospecting was carried on during the latter part of the year, two miles west of Statesville, and several veins were located, from which about 9,000 pounds of corundum were taken, but no regular operations have as yet been instituted.

MICA.

During 1892 there were in operation some ten or twelve mica mines, situated principally in Mitchell and Yancey counties. The total production of these mines is estimated

at 10,000 pounds of cut mica, valued at about $35,000. The average price of 3 by 5-inch cut mica, at the mines, is put at $3.50 per pound.

During the year three mills, manufacturing ground mica from waste scraps, were in operation in Mitchell county, but no estimate can be made of their output.

TALC.

The total production of prepared talc (shipments from mills) for 1892 is estimated at 2,500 net tons, valued at about $19,000 at the mills.

The two principal producers were *The Notla Consolidated Marble, Iron and Talc Company*, of Cherokee, and *Messrs. Rickard and Hewitt*, of Swain county.

KAOLIN.

The total production of prepared kaolin for 1892 is estimated at 3,900 net tons, valued at $31,200 at the works.

The principal producers were the works at Sylva and Dillsboro, in Jackson county.

ADDITIONS TO THE BREEDING AVI-FAUNA IN NORTH CAROLINA SINCE THE PUBLICATION OF PROF. G. F. ATKINSON'S CATALOGUE IN 1887.

BY J. W. P. SMITHWICK.

1. Great Blue Heron (*Ardea herodias*). Young ones have been seen and taken in all sections.

2. Little Blue Heron (*Ardea cærulae*). Reported breeding in the west by Mr. John S. Cairns, Buncombe county.

3. Red-tailed Hawk (*Buteo borealis*). One nest containing two eggs was found by myself in Bertie county, 1888.

4. Broad-winged Hawk (*Buteo latissimus*). Breeds in middle and western sections. (Brimley and Cairns).

5. American Sparrow Hawk (*Falco sparverius*). Nests have been found in all sections; I have noted several in the east.

6. American Osprey (*Pandion haliætus carolinensis*). Have noted two nests in Bertie county and seen young ones several times; reported breeding along the larger streams of the west by Cairns.

7. Black-billed Cuckoo (*Coccyzus erythrothalmus*). Reported breeding in Wake county by Brimley; Cairns says that it breeds during some seasons in the mountains.

8. Belted Kingfisher (*Ceryle alcyon*). I found a nest containing seven eggs in 1889, which was placed at the end of a burrow in a bank on the Cashie River near its mouth; breeds in the west. (Cairns).

9. Hairy Woodpecker (*Dryobates villosus*). Said to breed in the higher mountains of the west by Cairns.

10. Yellow-bellied Sapsucker (*Sphyrapicus varius*). Reported breeding by Cairns in Buncombe county on higher mountains.

11. Red-headed Woodpecker (*Melanerpes eryphrocephalus*). Found commonly breeding in all sections.

12. Red-bellied Woodpecker (*Melanerpes carolinus*). Rather rare breeder in all sections of the State.

13. Chuck-will's-widow (*Antrostomus carolinensis*). Three nests, containing two eggs each, were found by myself in Bertie county; one in 1888 and two in 1891.

14. Night-hawk (*Chordeils virginianus*). Found breeding in the eastern section by myself.

15. Least Flycatcher (*Empidonax minimus*). Reported as a rare breeder in mountains by Cairns.

16. American Crow (*Corvus americanus*). Found breeding in all sections, common.

17. Boat-tailed Grackle (*Quisculus major*). One nest containing four eggs was taken in Plymouth from an old elm overgrown with ivy, in 1889, by myself.

18. Towhee (*Pipilo erythrothalmus*). Reported by Cairns as breeding in Buncombe county.

19. Rose-breasted Grosbeak (*Habia ludoviciana*). Said to breed on craggy mountains by Cairns.

20. White-bellied Swallow (*Tachycineta bicolor*). Several nests containing eggs have been taken by my cousin (T. A. Smithwick) and myself in the last few years.

21. Logger-head Shrike (*Lanius ludovicianus*). Reported breeding in Iredell county by McLaughlin.

22. Warbling Vireo (*Vireo gilvus*). Reported breeding along the rivers in the mountain section by Cairns.

23. Yellow-throated Vireo (*Vireo flavifrons*). I have taken two nests in Bertie county; no others have been recorded.

24. Mountain Solitary Vireo (*Vireo solitarius alticola*). Found breeding in the higher mountains by Cairns.

25. White-eyed Vireo (*Vireo noveaboracensis*). Breeds throughout the State, common.

26. Prothonotary Warbler (*Protonotaria citrea*). I found one nest in 1888 in Bertie county which contained three eggs; this is the farthest north that any nest has been recorded on the Atlantic slope, so far, I think.

27. Worm-eating Warbler (*Helmintherus vermivorus*). One nest was found in Bertie county by T. A. Smithwick and one in Buncombe county by Cairns last spring; this shows that it may breed in all portions.

28. Blue-winged Warbler (*Helminthophila pinus*). Said to breed in the mountains by Cairns.

29. Magnolia Warbler (*Dendroica maculosa*). Breeds in the west; young ones have been seen in July by Cairns.

30. Oven-bird (*Seiurus aurocapillus*). One nest was found in Bertie county in 1892 by myself.

31. Hooded Warbler (*Sylvania mitrata*). I found one nest in 1888, and since that time a great many nests have been found by my cousin and myself in Bertie county. Not reported from any other section.

32. Winter Wren (*Troglodytes hiemalis*). Two nests were found by Cairns on the Black mountains in the spring of 1892.

33. Golden-crowned Kinglet (*Regulus satrapa*). Reported breeding on Black mountains by Cairns.

34. Olive-backed Thrush (*Turdus ustulatus swainsonii*). One nest has been reported, it being found on Black mountains by Cairns.

CONTRIBUTIONS FROM GEOLOGICAL DEPARTMENT UNIVERSITY OF NORTH CAROLINA.
No. I.

AN EXAMPLE OF RIVER ADJUSTMENT.

BY CHARLES BASKERVILLE AND R. H. MITCHELL.

One could scarcely find an example which more fully illustrates the principles involved in determining the courses of streams than the Jackson River in western Virginia. This is a small stream rising near Monterey, Highland county, flowing south-west through Bath into the James River at Covington, Alleghany county.

The existing topography is the result of the denudation following upon the great Permian deformation, which gave rise to the main ranges of the Appalachians. From

this upheaval dates the beginning of the history of the rivers of this region.

Fig. 1

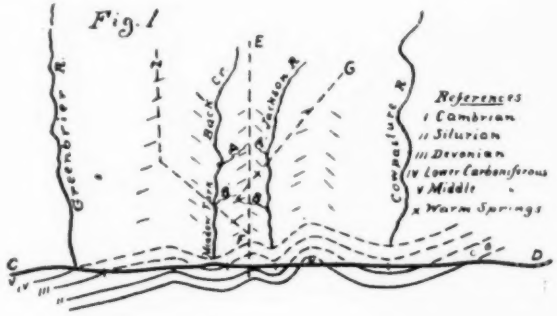


Fig. 2

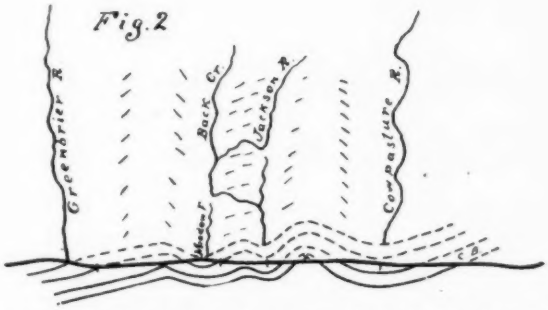


Diagram I gives a rough perspective of this immediate region, together with a vertical section in a north-west and south-easterly direction, just south of Warm Springs. In the vertical section the unbroken lines represent the geological structure of the present topography (heavy line CD) and the dotted lines the same in Permian time. The perspective shows the drainage consequent upon the deformation, and combining the two, it can be seen that the Jackson River flowed down a syncline in a south-westerly direction on a bed of the lower carboniferous rock. Parallel to this, and in a similar syncline on the

same stratum with lower level, flowed now Back Creek, formerly Meadow Fork of the Greenbrier River, West Virginia. Tributary A of Back Creek, on account of steepness of slope, gnaws back, capturing headwaters of Jackson River by tributary A^1, causing the same to have its outlet in a north-westerly direction, thus throwing the water-shed east (GF) between Cowpasture and Jackson Rivers, which previously (EF) was between Jackson River and Back Creek. The base of the syncline, then the bed of Back Creek (Meadow Fork), was nearer base level than base of Jackson River syncline, consequently the softer Devonian slates were reached first by the latter. With conditions thus changed the tributary B of Jackson River captures in turn the headwaters (B^1) of Meadow Fork (Back Creek), and the water-shed (HF) as now exists was shifted west between Greenbrier River and Meadow Fork of same and Back Creek. Diagram II shows the present flow of waters of Jackson River.

UNIVERSITY OF NORTH CAROLINA.

CHARACTER AND DISTRIBUTION OF ROAD MATERIALS.

BY J. A. HOLMES.

In the following discussion of the character and distribution of road material in the State it is thought best to avoid the use of technical terms as far as possible; and the names of rocks here used are those applied by the engineer rather than by the geologist. The character of the materials is discussed with a view to their fitness for use in the construction of broken-stone pavement, as used by Macadam and Telford on the public highways.

CHARACTER OF ROAD MATERIALS.

"In considering the relative fitness of the various materials," says Byrne,* "the following physical and chemical qualities must be sought for:

"(1). Hardness, or that disposition of a solid which renders it difficult to displace its parts among themselves.

"(2). Toughness, or that quality which will endure light but rapid blows without breaking.

"(3). Ability to withstand the destructive action of the weather, and probably some organic acids produced by the decomposition of excretal matters, always present upon the roadways in use.

"(4). The porosity, or water-absorbing capacity, is of considerable importance. There is, perhaps, no more potent disintegrator in nature than frost, and it may be accepted as fact that of two rocks which are to be exposed to frost, the one most absorbent of water will be the least durable."

The following table shows absorptive power of a few common stones:†

	Percentage of Water Absorbed.		Percentage of Water Absorbed.
Granites	0.06 to 0.155	Limestones	0.20 to 5.00
Marbles	0.08 to 0.16	Sandstones	0.41 to 5.48

Something of the quality and suitability of different materials for use in broken-stone pavements is shown in the following table:‡

Materials.	Co-efficients of Wear.	Co-efficients of Crushing.
Basalt	12.5 to 24.2	12.1 to 16.
Porphyry	14.1 to 22.9	8.3 to 16.3
Gneiss	10.3 to 19.0	13.4 to 14.8
Granite	7.3 to 18.0	7.7 to 15.8
Syenite	11.6 to 12.7	12.4 to 13.0
Slag	14.5 to 15.3	7.2 to 11.1
Quartzite	13.8 to 30.0	12.3 to 21.6
Quartzose sandstone	14.3 to 26.2	9.9 to 16.6
Quartz	12.9 to 17.8	12.3 to 13.2
Limestone	6.6 to 15.7	6.5 to 13.5

*Highway Construction, p. 24. †*Ibid.*, p. 26. ‡*Ibid.*, p. 172.

These "co-efficients," showing the relative quality of various road materials, were obtained by French engineers as the result of an extended series of tests, and were found to agree fairly well with the results arrived at by actual observation of the wear of materials in the roads. The co-efficient 20 is equivalent to "excellent," 10 to "sufficiently good," and 5 to "bad."

STONES NOT SUITABLE AS ROAD MATERIAL.—Before proceeding to the consideration of the stones found in North Carolina adapted to use as road material it may be well to consider briefly some of those that are not suited to this purpose. In general, it may be said that all *schistose* and *slaty* rocks, *i. e.*, all rocks which split or break easily into layers or flakes, should be discarded. No rock of whatever species which is already in the advanced stages of decay, so as to become crumbly and soft or porous, should be used in macadamizing roads, as the result in all such cases will be that, under the action of the wheels and hoofs, these materials become ground into fine powder, which becomes mud when wet, and dust when dry. There are many places, however, where a decayed granite or gneiss rock, when highly siliceous, will make a good foundation for a Macadam road, and will be found useful as a covering on clay in the improvement of dirt roads. There are other materials, like quartz ("white flint"), which are hard enough, but which are quite brittle, and hence easily crushed to powder, and which, consequently, should not be used when better material is available. Sandstones, as a rule, are unfit for use in macadamizing roads, as they are easily crushed and usually porous.

STONES SUITABLE AS ROAD MATERIAL.—"The materials used for broken-stone pavements must of necessity vary very much according to the locality. Owing to the cost of haulage, local stone must generally be used, especially if the traffic be only moderate. If, however, the traffic is

heavy, it will sometimes be found better and more economical to obtain a superior material, even at a higher cost, than the local stone; and in cases where the traffic is very great the best material that can be obtained is the most economical."* In the middle and western counties of the State, in many places, stones now covering the cultivated fields will be found satisfactory for use on the roads, and in order to get rid of them farmers will haul and sell them for low prices.

Stones ordinarily used in the construction of Macadam and Telford roads are the following: Trap, syenite, granite, gneiss, limestone, quartzite, gravel and sand. The first three of these names are used here in a very general sense, and include several species of rock which, in technical language, would be known by other names. In general, it may be said that they rank in importance about in the order named, but several of them, especially the granite, gneiss and limestone, vary so much in quality that this general statement is subject to modification accordingly.

The term *trap*, as here used, includes not only the black, rather fine-grained, igneous rock known as diabase, which occurs in long dykes in the sandstone basins of Deep and Dan Rivers, but also the somewhat similar material which is to be found in the older crystalline rock of many other regions. In this State it is often known locally under the name of "nigger-head" rock. This rock does not usually split well into paving blocks, but when properly broken it is the most uniformly good material obtainable for macadamizing public highways, though sometimes it does not "bind" well.

Syenite, sometimes called *hornblende granite*, varies somewhat in quality and composition. It is a widely distributed rock in the midland and western counties of

*Byrne, Highway Construction, p. 170.

North Carolina, and is an excellent road material. The varieties which are finer in grain, and those having the larger proportion of the black mineral known as hornblende and are consequently of darker color, are best adapted for this purpose.

Granites vary considerably, both in quality and appearance, and in their value as road material. Those which are very coarse in grain, containing large and numerous crystals of feldspar, are, as a rule, more easily crushed and decay more rapidly, and should not be used in road construction when better materials are available. Those which contain a large proportion of mica split and crush more easily into thin flakes and grains, and for this reason are also less valuable. Those varieties which are of fine grain and contain an admixture of hornblende are best for road purposes.

Gneiss, which has the same general composition as granite, also varies very greatly in its quality and adaptability to road building. It usually has the appearance of being somewhat laminated or bedded, and when the layers are thin and the rock shows a tendency to split along these layers it should be discarded for road purposes. In addition to this, the statements made above with reference to the granites will apply also to gneiss.

Limestone suitable for road purposes is not an abundant rock in North Carolina, but it is found in a few of the eastern and a few of the western counties. It is a rock which varies very greatly in character, from the hard, fine-grained, compact magnesium limestone, which is a most excellent material for the Macadam and Telford roads, to the porous, coarse and partially compact shell-rock of recent geological formation, which is less valuable material. Practically all limestones when used as road material possess one valuable qualification, that of "binding"; the surface material which becomes ground by the action of

the wheels settles among the fragments below and consolidates the entire mass. For this reason, in many cases, it has been found to be good policy to mix a considerable quantity of limestone with some siliceous and igneous rock, which though hard and tough does not consolidate readily.

Gravel and Sand are not used in the construction of stone roads as formed by Macadam and Telford, except as an excellent foundation, for which purpose they possess a very great value; and as a binding material, in small quantities, they are sometimes spread over the road surface between the layers of crushed stone. When used in this latter connection, however, the gravel must be quite free from round pebbles. Gravel is, however, used extensively in the construction of what are termed gravel roads; where there is no attempt at macadamizing the roads, but where the gravel itself is spread uniformly over the surface of a foundation road-bed which has been properly shaped and drained. Gravel like that which occurs so abundantly in many Northern States, where glaciers existed, is not found in North Carolina. But river gravels are found in a number of our counties; and, as suggested above, in the middle and western counties there are to be found in places decayed siliceous granite and gneiss which, though not suited for mixing with crushed stone in macadamizing roads, yet will be found to serve a useful purpose as a foundation for the broken stone on clay roads, and also as a top dressing on clayey dirt roads.

DISTRIBUTION OF ROAD MATERIALS.

A line drawn from Gaston to Smithfield, Smithfield to Cary, and from Cary to Wadesboro, separates the State into two general and well-marked divisions, the eastern of which may be called the Coastal Plain region, and the western may be termed Piedmont and Mountain regions.

In the Coastal Plain Region.—In the eastern counties, except along the western border of this Coastal Plain region at irregular intervals, we find none of the hard crystalline rocks suitable for broken stone roads. Over the larger part of the area we have sand, clays and loams, the sands becoming coarser and more gravelly along the western border and finer towards the eastern. At a number of points along some of the rivers and in some intervening areas is to be found a limestone rock which will serve a fairly good purpose in road-building.

Gravel.—The gravel along this western border can be used successfully in making a fairly good road-bed, and should be used extensively where the hard crystalline rocks cannot be obtained. It may be found at many places in counties between the line mentioned above, extending from Gaston to Wadesboro, and a line drawn to the east of this from Franklin, Virginia, by way of Scotland Neck, Tarboro, LaGrange and Clinton, to Lumberton; and in a few places also considerably to the east of this latter line. The gravel is more generally distributed along the borders of the river basins, where it occurs in extensive beds, a few inches to twenty feet in thickness, though along the western edge of the Coastal Plain region it is often found on the hill-tops and divides between the rivers.

In many places the gravel is suitable for use on the road-bed just as it comes from the pit, containing pebbles of the right size, from an inch down to a coarse sand, and a small percentage of ferruginous clay, just enough to make it pack well in the road-bed without preventing proper drainage. In many cases, however, the proportion of clay and loam and sand is too large and must be reduced by the use of fine screens; and in other cases many of the pebbles are so large that they must be separated by means of a one-inch mesh screen, and those too large to pass through this screen broken before they are used.

The railroads passing through this region long since discovered the value of this gravel as a road material, and have used it extensively as a ballast on their road-beds. The small percentage of ferruginous clay soon cements the gravel into a hard, compact mass.

Limestone.—In the south-eastern portion of this region limestone rock and calcareous shells from the oyster and from fossil mollusks from the marl beds constitute the only hard materials to be found there for road construction. In some places the limestone is fairly hard and compact, as at Rocky Point, on the Northeast Cape Fear River, at Castle Hayne and elsewhere, and this rock will make an excellent road. In other places it is made up of a mass of shells firmly cemented together, as on the Trent River, near Newbern, and elsewhere. At many other points beds of shells are so slightly cemented together that the material may hardly be called a rock, as the term is ordinarily used, and in this condition it is of less value as a road material, but may be used for this purpose to advantage. A careful search will show limestone of one of these grades to occur in considerable quantities at many points in these eastern counties, between the Tar River and the South Carolina line. The harder, the more compact, and finer grained this rock, the more valuable it is as a road material; but the loose shells from marl beds, when free from clay, and the oyster-shells from the coast, when placed on a road surface and ground into fine fragments by travel, will solidify into a hard, compact road, as may be seen in the case of the excellent "shell road" between Wilmington and Wrightsville, which was built of oyster-shells.

Clay and Sand.—The admixture of a small percentage of clay or loam with the sand on the surface of the road-bed will solidify it, and will thus very greatly improve the character of the road; and in this connection, and only in this connection, clay may be considered a useful road

material. In whatever region the clay occurs in abundance the road will be greatly improved by the proper admixture of sand from an adjoining region, and by proper drainage.

Granites and other Crystalline Rocks.—These are found outcropping at intervals along the western border of the Coastal Plain region, and wherever found accessible this material should be used in the construction of roads. Near the northern border of the State they are found exposed in considerable quantity; along the Roanoke River, between Gaston and Weldon, in Northampton and Halifax counties; near Whitaker's Station, at Rocky Mount, just south of Wilson, and again a few miles north of Goldsboro on the Wilmington & Weldon Railroad. Another isolated and interesting occurrence of granite is near the junction of Pitt, Wilson and Edgecombe counties, where it is exposed over a tract of several acres. West of the Wilmington & Weldon Railroad, in the counties of Halifax, Nash and Johnston, the streams have removed the surface sands and clay in narrow strips along their borders, and have exposed at intervals the crystalline rocks; and in many places these rocks will be found to make good road material. Further south-west, in Wake county, on the Cape Fear River, and Upper Little River, in Harnett county, and again along the banks of the Pee Dee River and tributaries in Richmond and Anson counties, granitic and slaty rocks occur in considerable quantities, the former especially suitable for road material.

In considering the materials for good roads in the counties of this Coastal Plain region it must also be borne in mind that several large rivers connect this region with ample sources of granite and other good road materials which occur at the head of navigation on these streams and can be cheaply transported on flats; and further, that a number of railroads pass from the midland counties

where the supply is abundant directly into and across the Coastal Plain region.

Plank Roads.—As suggested above, in deep sandy regions where timber is abundant the plank road may prove the most economical good road that can be built for temporary use, and some of them last six to ten years. But the greatest objection to them lies in the fact that when the timbers decay, whether this be at the end of four or ten years, the road is gone; and the entire cost in labor and money must be repeated.

In the Midland and Piedmont Counties.—Throughout the midland and Piedmont counties of the State, west of the Coastal Plain region, rocks suitable for road purposes are abundant and widely distributed, so that no one can claim as an excuse for *bad* roads that the materials are not at hand for *good* roads. It will serve our present purpose to discuss these in the order of their geographic distribution, with but little regard to their geologic relations.

Trap Rock in the Sandstone Areas.—As stated above, sandstones possess very little value as road material, especially when broken into fragments, as is necessary in making Macadam and Telford roads, but fortunately in this respect the sandstones of North Carolina are quite limited in their distribution. The larger of the two areas begins near Oxford, in Granville county, and extends south-westward, passing into South Carolina below Wadesboro. It has its maximum width of about sixteen miles between Chapel Hill and Cary, and its average width is less than ten miles. It occupies the southern portion of Granville county, the southern half of Durham, the western border of Wake, the south-eastern border of Chatham, and portions of Moore, Montgomery, Anson and Richmond counties. The other sandstone area is much more limited in extent. It lies mainly in Stokes and Rockingham counties, along the Dan River, between Germantown and the Virginia line, a

length of not more than thirty miles, and a maximum width of not more than five miles.

Fortunately for the roads leading through these sandstone areas there is an abundance of a hard, black, tough, fine-grained rock, known as diabase, or trap, occurring in dykes which have broken through the sandstone and now appear on the surface in lines of more or less rounded black masses of rock running nearly north and south. These dykes vary in width from a few feet to more than one hundred feet, and are separated from one another by distances varying from a few yards to two or three miles. A dozen or more of these dykes are crossed by the wagon road between Chapel Hill and Morrisville. Several dykes occur at and near Durham, and the rock has been used upon roads leading out from Durham, but unfortunately it has not been crushed into small fragments, as should have been done, and hence the result has not been altogether satisfactory.

There is, probably, in both these sandstone areas a sufficient amount of trap rock to properly macadamize every prominent road that crosses them, and, after this has been done, to furnish a top dressing for all public roads which are likely to be macadamized in the adjacent counties.

Trap Rock in Other Areas.—Fortunately this excellent road material is, in its occurrence, not limited to the sandstone regions. Dykes quite similar to those which abound in the areas just described are also found extending across the country in many of the midland and Piedmont counties, and also the region west of the Blue Ridge. Heretofore this black, "nigger-head" rock, as it is frequently called, has been regarded as a useless encumbrance of the ground; now, in connection with the move for better roads, it must be regarded as one of our most valuable rocks. The city of Winston has already made extensive use of it in macadamizing its streets, with excellent results.

The Eastern Granite Belts.—Granitic rocks are abundant over considerable areas in the midland and Piedmont counties, and especially in the former. One of these important areas may be called, as a matter of convenience, the Raleigh granite belt; which, in a general way, may be described as enclosed by lines drawn from Gaston to Smithfield, thence to a point midway between Raleigh and Cary, and thence a little east of north to the Virginia line. This belt occupies a considerable part of Wake, including the region about Raleigh, of Franklin, and practically the whole of Warren and Vance counties. The principal rocks of this belt are light-colored gray, comparatively fine-grained, granite and gneiss; on the whole a fairly good material for road construction. The rocks vary in composition and in appearance at different localities, but are fairly uniform in character over considerable areas. In some places the black or biotite mica is largely wanting, and the rock assumes a whitish feldspathic character; at other points the mica becomes abundant, and the rock assumes a dark gray color. In places the mica is so abundant that the gneiss becomes somewhat schistose, or laminated, and in this condition crushes easily, hence should not be used on the roads. Dykes of trap rock are occasionally met with, and these should be used in preference to the gneiss and granite wherever accessible.

The somewhat isolated patches of granite lying east of this belt in Halifax, Nash, Edgecombe and Wilson counties have already been referred to.

West of the Raleigh belt there is another granite area of limited extent which occupies the extreme north-eastern portion of Durham county and the larger part of Granville county. This may be called the Oxford granite belt. The rocks of this area resemble to some extent those of the Raleigh belt, but there is a larger proportion of syenitic and trap rocks, which make excellent road material.

The Central Granite Belt.—This belt extends obliquely across the State from near Roxboro, in Person county, to the South Carolina line along the southern border of Mecklenburg. Its width varies from ten to thirty miles, and it occupies a total area of about three thousand square miles in the following counties: Western half of Person, including the region about Roxboro; the south-eastern portion of Caswell, the north-western half of Alamance, the larger part of Guilford and Davidson, south-eastern portions of Davie and Iredell, Lincoln and Gaston and the larger part of Rowan, Cabarrus and Mecklenburg. In this belt throughout its entire extent road material of most excellent quality is abundant. The prevailing characteristic rocks are syenite, dolerite (trap), greenstone, amphibolite, granite and porphyry; and, as will be seen from this list, the tough hornblende and augite rocks predominate. Dykes of trap rock, some of them of considerable extent, are to be found in almost every portion of the belt. So uniformly tough and durable are these materials that one could hardly go amiss in making selections for road construction.

The Central Slate Belt.—This region lies just east of the central granite belt, and extends obliquely across the State from Virginia to South Carolina. Its eastern border lies against the Deep River sandstone basin described above (p. 23). It varies from twenty to forty miles in width and includes all or portions of the following counties: The eastern half of Person, the north-western part of Durham, the south-eastern part of Alamance, nearly all of Orange, Chatham, Randolph, Montgomery, Stanly and Union; the eastern part of Davidson and Rowan, and the north-western part of Anson. A considerable portion of this area is rich in other mineral products, but the entire belt, as compared with the central granite belt, is poor in road materials. The rocks are mostly siliceous and clay slates, with a considerable admixture of chloritic and hydromicaceous

schists; all of which are at best inferior for road construction. Here and there, however, trap dykes are found in this belt; and in places the siliceous slates become somewhat massive, passing into hornstone and a quartzite, which, when crushed, will answer fairly well for macadamizing purposes. In other places the chloritic schists become somewhat massive and tough and can be used in the same way. In still other places, as about the State University, and along the eastern border of Orange county, the rock is a fine-grained, tough syenite, accompanied by trap dykes, and is eminently suited for road purposes; and again, as near Hillsboro, granite occurs in a limited area. Vein quartz ("white flint") is abundant in many parts of the belt; and, though not usually recommended as road material, is worthy of consideration. While, then, on the whole the rocks of this belt are not suitable for use as road material, yet a careful search will show the existence of a sufficient quantity of material of fair quality to macadamize all the public roads. And should this supply ever prove insufficient, excellent materials are to be found in abundance in the granite belt along the western border of this region, and in the trap dykes of the sandstone on the eastern border.

The Gneisses and Other Rocks of the Piedmont Counties. —West of the central granite belt as described above, and extending back to the foot-hills of the Blue Ridge, is the region occupied by the Piedmont counties—Rockingham, Stokes, Forsyth, Yadkin, Surry, Wilkes, Davie, Iredell, Alexander, Caldwell, Burke, McDowell, Rutherford, Polk, Cleveland, Catawba, Lincoln and Gaston. The rocks of this region resemble in many respects those of the Raleigh granite belt. They consist of a succession of gneisses, schists and slates, more hornblendic toward the east and more micaceous toward the west, with here and there masses and dykes of syenite, trap and other eruptive rocks.

In places, as at Mount Airy, the true granite occurs in considerable abundance. The granites and gneisses, except where the latter tend to split into thin layers and crush, are fairly good materials for road construction, improving as they become finer in grain and as the percentage of hornblende increases; but the best material for road construction is to be found in the trap dykes and syenite ledges which at intervals traverse this region, more especially its eastern half.

The Gneisses and Other Rocks of the Mountain Counties.—The rocks of this region are not greatly unlike those of the Piedmont counties just described. Over much the larger part of the area rock fairly well adapted to road construction is abundant, indeed so abundant that the laborers on the public roads in that region during the past half century have expended the larger part of their time and energy in endeavoring to get this rock out of the way. Had they expended this time and energy in crushing the rock and spreading it over a well-formed foundation, this region would possess at the present time a number of excellent macadamized highways.

In the more northern counties—Alleghany, Ashe and Watauga—the predominating rocks are hornblende gneiss and slate, but massive syenites are abundant, especially between Rich mountain in Watauga and Negro mountain in Ashe county, and elsewhere. Further south-west, through Mitchell, Yancey, Madison and Buncombe counties, hornblende schists still continue, but they are more massive, and the gneisses predominate. These are, on the whole, compact and sufficiently tough for use in the construction of good Macadam roads. And the statement just made concerning these counties is also applicable to Henderson, Transylvania and Haywood counties, and in a measure to Jackson, Swain and Macon counties and the eastern half of Clay county, in all of which the supply of good road

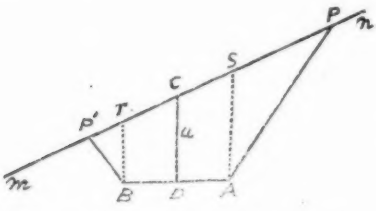
material is ample; but in these last three counties mica schist partially replaces the hornblende slate. In the western part of Swain, in Graham, Cherokee and the western part of Clay county good road material is not so abundant as in the other counties named, but nevertheless is to be found in considerable quantities. The rocks over a considerable portion of this last-named area are micaceous and hydromicaceous in character, and are practically worthless for the purposes of road-building, but the quartzite ledges and beds of limestone in these counties will furnish ample and suitable material.

In conclusion, it may be said that in the middle and western counties of North Carolina material suitable for macadamizing the public highways is abundant and generally accessible. It will be the exception, rather than the rule, that this material will have to be transported for any considerable distance. In the eastern counties materials suitable for this purpose are inferior in quality and only moderately abundant in quantity, but the extensive and intelligent use of even these materials would very greatly improve the public roads and thereby increase the prosperity of the people. And in many places where the Macadam road is at present out of the question on account of the lack of stone, other materials, gravel, clay, loam and plank will be found in sufficient abundance to make the construction of better roads practicable at reasonable cost.

TO SET SLOPE STAKES WHEN THE SURFACE IS STEEP BUT SLOPES UNIFORMLY.

BY J. M. BANDY.

Let *mn* represent the surface of the ground. Let C represent the position of the centre peg, and let CD (=*a*, the value of which is found from the level notes) represent the centre cut. The width of the road, BA, is *b*.



It is proposed to find what engineers designate as cuts at P, P', S, and T.

In the direction of P, and in connection with C, one setting of the rod determines the slope of the ground *mn*. Call this slope *m*. Now, since the cds. of C are (*o*, *a*), the equation of the surface, *mn*, is

$$y = mx + a, \quad \ldots\ldots (1).$$

The quality of the soil determines the slopes of PA P'B. Call this slope m'. Then since the cds. of A are $(\frac{b}{2}, o)$, the equation of PA is

$$y = m'x - \frac{m'b}{2}, \quad \ldots\ldots (2).$$

Combining (1) and (2), the cds. of P are known. Hence the cut at this point is known.

Designating the cds. of P, just found, by (x'', y'') and the cds. of C by (x', y') [$=(o, a)$],

$$CP = \sqrt{(x'' - x')^2 + (y'' - y')^2}, \quad \ldots\ldots (3).$$

Then measure this distance, CP, and fix stake at P.

The equation of SA is

$$x = \frac{b}{2}.$$

Substituting this value in (1), the cut S is at once obtained. Denoting the cds. of S by (x^{II}, y^{II}) and the cds. of C by (x^{I}, y^{I}), and substituting in (3), CS is known. Measure this distance, and fix stake at S.

The same course of reasoning applies in finding the cuts at P^{I} and T.

The writer has found this method more expeditious than *trial* and *error* when the surface was much inclined. The numerical computations did not require as much labor as manœuvering with the rod and level.

Since he has not seen the above method in any of the books which have fallen under his eyes, he has been induced to give it in the hope that it might prove useful, as well as suggestive, to others under similar circumstances.

TRINITY COLLEGE, N. C.

ON THE DEVELOPMENT AND A SUPPOSED NEW METHOD OF REPRODUCTION IN THE SUN-ANIMALCULE, ACTINOSPHÆRIUM EICHHORNII.*

BY JOHN M. STEDMAN.

Early in March my attention was called to an aquarium which had been standing in my window during the winter, and which contained anacharas and algæ in great abundance, but which now suddenly presented a quantity of light pink substance on the sides of the jar. It was the appearance of this pink-colored material among the *debris* of decaying and growing algæ that attracted my attention. Accord-

*Amer. Soc. Microscopists, 1888.

ingly a small piece of the substance was spread out on a slide and examined, when, to my surprise, it was found to be composed of sun-animalculæ of various sizes, among which were other bodies, the true nature of which I did not at first quite understand, but which on close examination proved to be the young of the larger heliazoa. So numerous, indeed, were the young heliazoa that not a single field of the one-fifth objective and *a* ocular could be chosen in which there were less than half a dozen, and usually the number was very much greater.

Such an unusually great and rare opportunity to study these animals could not be neglected. Fortunately they were discovered in the morning, and by close and constant observation for several hours their true relations to the numerous small bodies were satisfactorily demonstrated and proven to be different stages of the same animal.

For a description of *A. Eichornii* and of its habits see "Fresh-water Rhizopods of North America," by J. Leidy, p. 259. Plate XLI.

We will pass at once to the special subject in hand, beginning, for convenience, with the simplest or youngest heliazoan.

Development.—Let it not be understood that the order in which I am now to describe the different stages of development is the order in which I observed them. On the contrary, what I shall first describe really came about last in my observations, since I did not at first take the youngest stages of this heliazoan to have any connection with the larger heliazoa. My observations began with an undoubted heliazoan of this species (Fig 13 of my plate), and from that I worked both ways, but principally to the younger. It would have been impracticable to have watched the development of a single heliazoan from the very youngest individual to the full-grown animal, since it would have required not only a constant observation for a

much longer time than I could spare, but would also have needed some little care. As it was, I could watch a young heliazoan until it had developed a few stages, and had considerably lessened the near supply of food, and then I could find another heliazoan of the same stage as the one just discarded, but which was in more favorable circumstances for further growth. As indicated, the number of heliazoa was enormous, and the different stages were represented by the score. Had I suspected these various stages to have been what they were, there would have been no trouble in finding a complete set, for every gradation from the youngest to the adult was present in great quantities. Fortunately there were quite a number of worms—*Dorylaimus stagnalis*—in the water, and their constant wriggling about kept the heliazoa and other animals in perpetual motion, so that they came in contact with one another, where otherwise they would not have done so.

A far greater number of observations were made than I shall here describe. Enough were chosen, however, to form a complete series, and accurate drawings made of them. I shall, therefore, describe only those observations which I have illustrated, hoping that the series will be full enough for our purpose.

I think it is safe to say that were this minute mass of protoplasm which constitutes the youngest heliazoan observed by itself for a little while, no one would mistrust its true nature or relations. Indeed it was only after a long and continued observation, and that under the most favorable circumstances, that I became convinced of its true nature. It is nothing but a minute spherical mass of finely granular and hyaline protoplasm, 14.5 μ in diameter, with a contained nucleus and a distinct nucleolus (Fig. 1). In appearance it resembles white blood corpuscles with a distinct and sharply defined nucleus. Later, however, a vacuole appears in its substance, and, increasing in size,

often becomes larger than the original mass of protoplasm, so that the latter forms but a thin layer surrounding it (Figs. 2, 16, 12). In this stage a pseudopodeum or ray may be presented (Fig. 12).

Two heliazoa of the first stage were seen to come together, which, however, as in nearly all cases, was due to the agitation of the water by the worms, and immediately upon touching one another (Fig. 23), to fuse and run together just as a drop of water fuses with another drop of water. It is impossible to say which of the two was devoured; both appeared to play an equal part, the vacuole and nucleus of both being present, and the whole immediately assuming a spherical form and appearing (Fig 3) much like any one of the two of which it is now composed, except that it has two vacuoles and two nuclei. In the course of five minutes this young, two-vacuoled, heliazoan had developed a ray, and in its interior the characteristic axis thread could be distinctly seen (Fig. 20). The absence or the number of rays when present in the young heliazoa is of no special value, and varies with different individuals of the same age, as will be seen from the figures.

Whether this fusion of two individuals of the same species be called eating or not does not concern us, and I shall not attempt to discuss the subject here. As a matter of fact, however, it is not conjugation for purposes of reproduction or rejuvenescence, as will be seen later; and, since we have these animals developing by this method of increase as well as by that of an undoubted eating of other animals, it matters not, so far as development is concerned, whether they appropriate material so near like that of their own bodies that it needs no change to form a part of them, or whether the food be different and hence have to be changed or digested before it can be so appropriated. I have observed farther advanced heliazoa capture infusoria and amoeba and surround them, and draw them into their

interior, where they remained to be digested; and at the same time I have observed those same heliazoa capture other heliazoa, and instead of drawing them into their interior and surrounding them as they did other bodies, they would draw them in until the two heliazoa touched, when there occurred a fusing and blending of the two animals into one just so much larger. My only explanation is that, as indicated, the protoplasm of the two animals is *exactly alike* and hence there can be no need of digestion. Were one of the heliazoa dead when it came in contact with another which would otherwise have fused with it, I have no doubt but that the dead heliazoan would be surrounded and drawn into the interior of the live one the same as other animals are and there digested, it being *not exactly like* the protoplasm of the one which is alive. For if this were not the case, if the dead heliazoan upon contact with the living heliazoan were to form a part of it as the living heliazoan did, then we should have a case where simple contact of the living protoplasm with the same but dead protoplasm would impart life to the dead, just as a piece of iron which is magnetized, if brought in contact with one which is not, will impart magnetism to it. But it is needless to say that such a phenomenon of life has never been observed.

While watching the heliazoan (Fig. 3, 20) which we have just described as being the result of the union of two of the youngest individuals (Fig. 2, 23), the water was stirred by a worm, and another heliazoan, of about the same size as the one under observation, but with three vacuoles and no rays, was brought nearer and nearer until finally they accidentally came in contact with one another and immediately united (Fig. 20) and assumed a spherical form. Presently the single ray disappeared and three more vacuoles made their appearance in the mass of protoplasm together with the development of a contractile vesicle

(Fig. 5). This individual was watched until it had developed three rays and several more vacuoles (Fig. 6), a process requiring about twenty-five minutes, during which time it had eaten nothing except one of the youngest heliazoa without a vacuole. Under the one-twelfth oil emersion I was able to detect the axis cylinder in two of the rays, but not without some doubt in the third ray.

Very near this individual (Fig. 6, 26) was another heliazoan of a much greater size (Fig. 25), and by touching the cover-glass with a needle I soon brought the two so near that the tip of one of the rays of the smaller heliazoan touched the larger animal. Wishing to observe the result of this contact I waited a few minutes, when it became apparent that the smaller individual was drawing in its ray, which was in contact with the larger heliazon, and was thus drawing itself towards it. The larger animal, offering the greater resistance, did not appear to move. Five minutes from the time the ray first touched the other heliazoan the two had come in contact, whereupon a union occurred and immediately the two blended into one. The smaller animal appeared to flow into the larger and to disperse itself through it in a manner which is common to all these animals, young as well as full-grown, and which will be described later when we reach a nearly mature heliazoan. Before the union of these two animals they appeared alike except in size and number of vacuoles, but shortly after the union the granules in the protoplasm gradually moved towards the center of the animal, where they became more numerous, and instead of being evenly distributed throughout the granular protoplasm now formed a central, more granular portion with an outer, clearer, and less granular zone. Three more rays were also developed, and the animal presented the appearance shown in figure 7, which, at this stage, would probably not be mistaken for any other species. Hundreds of individuals

were to be found of this size and appearance, and hence it was not necessary to watch the development of this single individual longer, as other fields promised better results.

There was almost an unlimited supply of heliazoa intermediate in size between the two whose union produced the one just mentioned. They differed in no respect from one another or from the two just mentioned, except a slight difference in size, and every gradation between them was to be found. Merely for the sake of filling up the gap which exists in regard to size between the two individuals whose union we just referred to, I will cite one example out of many which I have observed. Two similar individuals, slightly larger than the smaller (Fig. 26) of the two just united were seen to come together (Fig. 22), and, as a result of their union, a heliazoan was produced so nearly like the larger (Fig. 25) of the two of the former individuals, that there was practically no difference between them.

Another field was now chosen in which were a number of heliazoa, similar in all respects to the one representing our last stage (Fig. 7). I had not waited long before it was evident that two of these animals were gradually approaching one another from some cause which I was unable to discover. When within a very short distance, in fact, almost ready to meet, there occurred a very singular movement on the part of both individuals—a movement which I can hardly account for—in which there was produced a swelling, as it were, in that part of the sphere of both animals (Fig. 8, 9) which was just about to touch the other, and by continued enlarging with increased rapidity soon met one another, thus uniting the two individuals much more quickly than they otherwise would have done. Immediately upon touching one another the at first narrow neck uniting them rapidly enlarged (Fig. 10), the protoplasm of the one flowing into the other and *vice versa* until

the two animals had united into an oblong-shaped mass. The flowing of the protoplasm from one to the other was a most interesting sight, and could be distinctly seen, owing to the numerous granules which it contained. Both animals played an equal part in the union; a current of protoplasm could be seen streaming from the first into the second, and near it another current from the second into the first. There were as many currents as there were threads of denser protoplasm uniting them. Like all the observed cases the denser and more granular portions of the protoplasm separating the vacuoles from one another never mixed with anything but the corresponding protoplasm of the individual with which it united; hence there was no destruction of vacuoles, but merely an addition or union, and, moreover, the peripheral layer of vacuoles always remained on the periphery, while the central mass of vacuoles flowed to the center of the united mass. The heliazoan now gradually changed from the oblong or ellipsoid shape to that of a sphere (Fig. 11), and here I left it to seek other fields.

A nearly identical individual to the one just mentioned was found and seen to capture by one of its rays another but smaller heliazoan. As a result of a movement of the water the smaller individual chanced to come in contact with the tip of a ray of the larger animal and there to unite with it, whereupon the larger heliazoan gradually drew in its ray and the smaller creature with it. It was an interesting sight to see this process. The ray seemed rather to flow into the spherical mass or body of the animal, since a stream of protoplasm was rapidly and constantly flowing down its center into the animal, and the smaller heliazoan was likewise flowing into the larger by this means; but, nevertheless, the ray grew shorter and shorter until finally the heliazoa came in contact (Fig. 13), and then a union took place similar to the one described above,

except that here the flow of protoplasm appeared to be solely from the smaller to the larger animal. Before the animal had become entirely spherical, the denser inner portions of the smaller heliazoan had united with that of the larger and appeared as a swelling upon it, while the peripheral zones of both animals had united. This appeared to be such a good example of the mode of union of the protoplasm of two heliazoa that I figure it (Fig. 15).

I have observed a number of large heliazoa capture the youngest individuals, and in all cases as soon as the young animal touched the ray of the larger it appeared, so to speak, to form a part of it, and would sometimes assume an oval form and remain on the ray, looking exactly like the little knobs of protoplasm which are frequently seen there, except that it would be larger; and then again I have seen them flow down the center of the ray, while the ray itself suffered no appreciable change. In one instance, however, which came under my observation, a moderate sized heliazoan (Fig. 17) captured by the tip of its ray one of the youngest individuals (Fig. 16), and while watching to see what would happen to this young one, the ray of a large heliazoan (Fig. 18) came in contact with the larger of the former animals. Out of curiosity merely I watched to see the result of this extraordinary union, and found that the largest heliazoan drew its captured brother to itself and united with it before the smallest individual had touched the body of the one to which it was attached; the smallest heliazoan then appeared to be fastened to a ray of the largest animal, which, however, soon drew it to itself and the two united.

Quite a different process from the one we have been discussing occurs when the heliazoan encounters food consisting of other animals or plants. I have no doubt but that the youngest heliazoan, as well as those of all stages, are able to and generally do develope and reach maturity by

the use of no food other than that of other animals and plants; but there is also no doubt that this is a process requiring considerable time as compared with that which occurs when they chance to meet with their own kind, since in the former case the food has to be digested, while in the latter it has not. It was my good fortune to find a large heliazoan which had just captured an infusorium and partially surrounded it. In a few minutes the infusorium was completely enclosed, a clear space remaining around it, however, and gradually it was moved near the center of the animal, where it could be seen slowly moving its cilia in the little water which immediately surrounded it and which separated it from the protoplasm of the heliazoan (Fig. 19, 21). Presently an amoeba came in contact with the heliazoan and appeared to stick to it more or less and to constantly try to move away from it. The heliazoan made several efforts to surround it, but the amoeba in every case moved out before being fairly imbedded, and finally, after several minutes of hard struggling to ascertain which was to be victorious, the amoeba escaped. It was but a short time, however, before another amoeba chanced to touch the heliazoan, and this time with better success to the heliazoan. The amoeba, as soon as it touched the heliazoan, spread out a little on it, and at the same time the protoplasm of the heliazoan began to flow around and to enclose the amoeba, which now made several efforts to escape, but in vain, for within a few minutes a fine film of protoplasm had surrounded it, and the amoeba was within the heliazoan (Fig 19). A quantity of water was also enclosed with the amoeba, and in this it exhibited considerable activity, even after it had been carried nearly to the center of the heliazoan (Fig. 21). It was not long, however, before the amoeba had assumed a globular form and become motionless. I mention this instance in which the heliazoa eat other animals merely to bring out the strik-

ing difference between the process and that observed when they eat their own species.

Dr. Joseph Leidy* speaks of having found several globules of granular protoplasm with vacuoles and rays, and alludes to their probable connection with this species of heliazoa. I have reproduced in figure 24 one of his figures of these bodies, and think that there is every reason to believe that they are what he suspected them to be.

Reproduction.—It is not uncommon to find heliazoa in the process of reproduction by fission; in fact, if heliazoa be kept for any considerable length of time they are almost certain to be found in the act of reproducing by this means. I have observed them divide by keeping them in a watch-glass under the microscope, and in one instance I watched uninterruptedly the process, from an oral heliazoan before the constriction began to appear, up to the division and entire separation into two animals. A complete set of drawings was made to illustrate the different steps, and I find by referring to my notes that one of the drawings is almost identical with figure 10, which represents the heliazoan in the process of union.

As regards reproduction in the heliazoa outside of the well-known process of fission, all I can say is from a philosophical stand-point, as no direct observations have been made outside that of the finding of the young. But the presence of young has got to be explained in some way. From Dr. Leidy's "Fresh-water Rhizopods," p. 260, I find that "according to Stein, Carter and other authorities, *A. Eichhornii* contains many nuclei, large individuals having a hundred or more." Whether this has any connection with the heliazoan's having devoured individuals of its own species and thus to have retained their nuclei, and so, by continually adding to the number every time it captured

*"Fresh-water Rhizopods of North America," page 262-3.

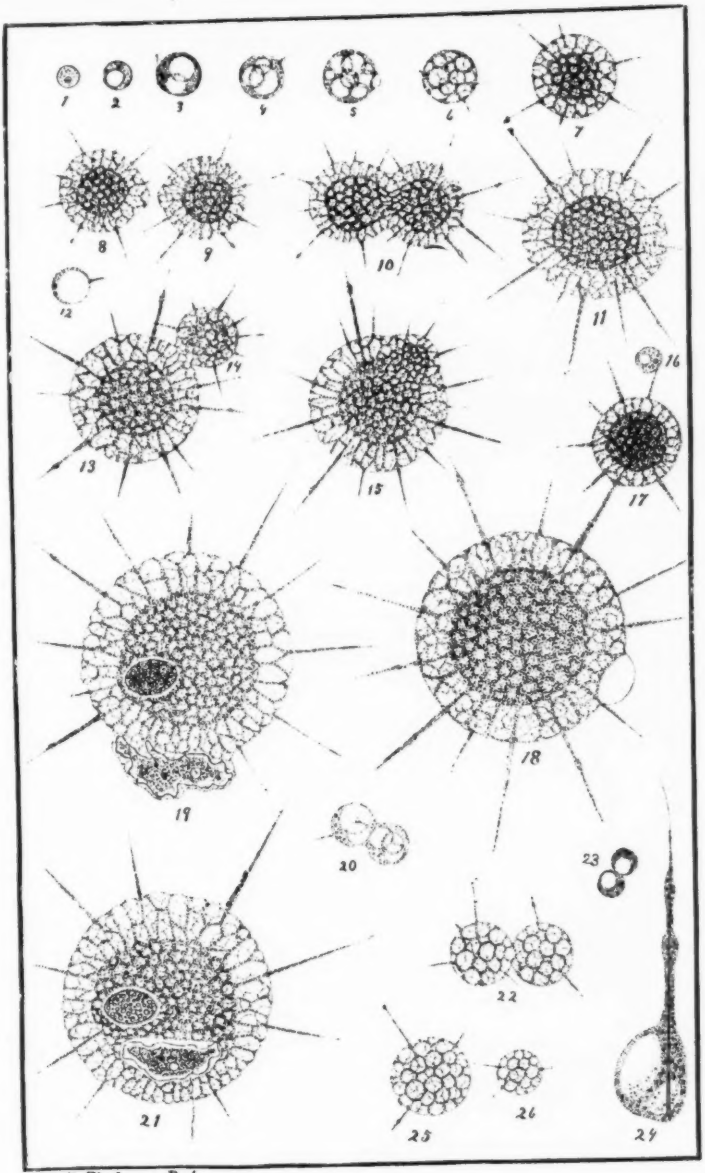
another heliazoan, to have finally attained the number of one hundred, or whether it is connected with the process of reproduction, I cannot say. It seems to me very probable that, in the fall at least, the full-grown heliazoan becomes encysted, and that its protoplasm then divides and subdivides, until it is converted into a mass of minute bodies, which, when the cyst is ruptured, make their escape into the surrounding water, and then appear as naked, spherical masses of granular protoplasm with a nucleus. It may be that the minute bodies acquire a covering before they escape from the mother cyst, and that they then act as spores, and are carried about and developed similar to the spores of infusoria.

Of course this mode of development has never been observed in the heliazoan, but it seems to me to be very probable that it does occur, judging from the observed young individuals, and from the fact that it occurs in certain infusoria.

EXPLANATION OF PLATE.

All the figures were drawn from life except Fig. 24, which is a reproduction of a figure from Dr. Leidy's work on the Rhizopods. Fig. 1, which is a heliazoan, *Actinosphaerium Eichhornii*, of the very youngest stage, is in nature 14.5 *u* in diameter. The other figures are drawn with the same magnification as Fig. 1, and hence they all bear the same relative size in nature as is here represented, excepting Figs. 25 and 26, which are a little too small. I take it to be of much more value to the reader to have the figures drawn so as to preserve their relative size, and then to know the natural size of one of them, than it is to have the figures of various magnifications and know the magnification of each separate figure. I do not wish it understood that the figure taken from Leidy is relatively of the same size as the other figures.

TRINITY COLLEGE, N. C.



J.M. Stedman. Del.

SOME FUNGI OF BLOWING ROCK, N. C.

BY GEORGE F. ATKINSON AND HERMANN SCHRENK.

During the month of August for the summers of 1888 and 1889 it was the good fortune of the senior author of this paper to spend that time in the enjoyment of the invigorating atmosphere and famous scenic beauty of this point in the Western North Carolina mountains.

To the greater number of the readers of this Journal Blowing Rock is not unknown. It may be a matter of interest to others to know that this now fast becoming popular summer resort is found in Watauga county, and is reached by "staging it" twenty miles up the mountain from a point, Lenoir, the northern terminus of the Chester & Lenoir Narrow Gauge Railroad, which connects with the main line of travel from the east and west at Hickory, on the Western North Carolina Railroad.

Even a botanist can cherish commendable curiosity, on his first trip to the place, concerning its "*entitlements.*" Upon reaching the summit near the village one is sped through an unpretentious drive of nearly one mile when the road curves to evade a steep hill. Here is suddenly presented to view the grand panorama of the great John's River valley below and the lofty peaks of the Black Mountains beyond.

When one has become disengaged from travelling paraphernalia, and when rest and refreshments have dispelled fatigue, there comes an irresistible desire to join others in the pilgrimage to the "Rock." Once there the meaning of "Blowing Rock" becomes apparent. The rock juts out upon the west side of the cliff, forming a bold precipice at the north-east of the John's River valley. The currents of

air from the farther end of the valley converge as they rise at this point, favored by the cliffs at the north and east, and on an otherwise calm day quite a strong breeze "blows" over the rock. Throw your hat, walking-stick, or what-not over the precipice and the wind brings them back to you. Legend has it that a despairing lover once leaped from the side of the fair one over the rock and the cruel winds picked him up and brought him back to her feet! It is proper to say, however, that when the writer visited the spot the winds did not seem to be "getting in their work" properly and there was no inclination to jump.

But legends and levity both aside, Blowing Rock is prodigal with flowers and "mushrooms." To one who visits the place in June the profusion of thickets painted with *Rhododendrons* and *Kalmias* are a "joy forever." Later in the season "Black-eyed Susans" wink at you here and there, and various species of interesting *Orchids* are frequently met with. *Eupatoriums* and other vigorous growers vie with each other in their effort to hide the fences which line the roads or cross the fields.

The great prodigality of the fleshy fungi tempted the writer, during portions of two short months, to form the beginning of a closer acquaintance with the *Hymenomycetes* than had been gained from a general study of structure and relationships. Accordingly collections were made of fungi chiefly in this group. Not wishing to be encumbered with books, no efforts were made at the time to identify the specimens. A few notes were taken on the more evanescent characters, the specimens were then dried and preserved for future determination.

The greater number of the *Hymenomycetes* were afterward determined by Mr. A. P. Morgan. Dried agarics are very difficult of determination and it is a matter of some interest that more than half of the *Agaricaceæ* were in a recognizable condition, though some genera like *Cortinarius* were complete failures.

One point of interest in making the collections was the observation that quite circumscribed areas for several days in succession would yield fresh and abundant specimens of the same species. Near Fair View and Sunset Rock *Boletus americanus* was abundant both seasons. A trip down the damp slopes of Glen Burney was almost sure to be rewarded by gorgeous *Thelephoras*. Partly down the John's River valley road, in rather open woods, several species of *Hydnum* would always insist on over loading one's basket. That lovely plant, *Mitremyces lutescens* Schwein., cropped out continually along certain of the shady clay road banks dripping with water. From the same situations where there was less water, clammy *Amanitas* lifted their heads. One point on the Valley Crucis road yielded *Strobilomyces strobilaceus*. Wonder Land produced monster clusters of *Clitocybe illudens*. At one time I could have picked more than a bushel without moving from the spot. This plant is remarkably phosphorescent, the phosphorescence being confined to the hymenium. Sometimes this plant is taken to the hotels, and at night the guests amuse themselves delineating various figures in the dark with the aid of this "fox-fire" mushroom. Another phosphorescent plant, *Panus stipticus*, is common upon dead stumps, etc. Close by the roadside at Wonder Land, also, *Cyclomyces greenii* was found. In an open field east of the Morris pasture the parasol, *Lepiota procera*, grew in abundance, and here and there the Ox-tongue, or beef-steak fungus, *Fistulina hepatica*, offered its juicy meat. *Lactarii* were everywhere and so the dainty *Marasmii*. *Marasmius capillaris* was taken, just a bit of it, from "Flat Top." *Bulgaria inquinans*, *Spathularia velutipes*, *Leotias*, were very common. The *Geoglossums* were rarely seen. *Geoglossum Walteri* was collected by Miss Etta Schaffner down in the John's River valley near the foot of Fair View. Down in the far depths of this valley was a profusion of the maiden's hair fern, *Adiantum capillis-veneris*.

The junior author, Mr. Schrenk, a student in botany in my laboratory, has rendered valuable service in making out the list presented below and in a careful examination of the specimens for the purpose of verification of the identifications, in order to lessen the chances of error. This has occasioned no inconsiderable labor on his part.

In the arrangement of the list the system presented in Saccardo's Sylloge has been mainly followed. No effort has been made at changes in nomenclature, since it did not seem to be called for in a bare list of no more than 254 species.

The *Saccharomyces pyriformis* and *Bacterium vermiforme** were symbiotic organisms composing small amber-colored grains termed "moss seed," "California beer seed," used by some of the mountain people in brewing a beer by placing the grains in water sweetened by molasses. The grains were given me by Dr. Carter, a resident physician.

ORDER HYMENOMYCETEÆ.

FAMILY AGARICACEÆ.

1. *Amanita cæsarea* Scop.
2. *A. muscaria* Linn.
3. *A. pantherina* DC.
4. *A. phalloides* Fr.
5. *A. recutita* Fr.
6. *A. solitaria* Bull.
7. *A. vernus* Fr.
8. *Amanitopsis vaginata* (Bull.) Roz.
9. *A. volvata* (Pk.) Sacc.

---

*See Ward. The "Ginger-beer plant," and the organisms composing it: a contribution to the study of fermentations—yeasts and bacteria. Proceedings of the Royal Society, Vol. 50, pp. 261, 265.

10. *Lepiota cristata* Alb. et Schwein.
11. *L. procera* Scop.
12. *Armillaria mellea* Vahl.
13. *Tricholoma fulvellum* Fr.
14. *T. portentosum* Fr.
15. *T. saponaceum* Fr.
16. *Clytocybe cyathiformis* Fr.
17. *C. illudens* Schwein.
18. *C. infundibuliformis* Schæff.
19. *C. laccata* Scop.
20. *Collybia confluens* Pers.
21. *C. radicata* Relh.
22. *Mycena corticola* Schum.
23. *M. galericulata* Scop.
24. *M. mucor* Batsch.
25. *M. stipularis* Fr.
26. *Omphalia fibula* Bull.
27. *O. scabriuscula* Pk.
28. *Pleurotus applicatus* Batsch.
29. *Hygrophorus cantherellus* Schwein.
30. *Lactarius albidus* Pk.
31. *L. chrysorrheus* Fr.
32. *L. cilicioides* Fr.
33. *L. cinereus* Pk.
34. *L. corrugis* Pk.
35. *L. fuliginosus* Fr.
36. *L. helvus* Fr.
37. *L. hysginus* Fr.
38. *L. insulsus* Fr.
39. *L. lignyotus* Fr.
40. *L. pergamenus* (Swartz) Fr.
41. *L. piperatus* (Scop.) Fr.
42. *L. pyrogallus* (Bull.) Fr.
43. *L. rufescens* Morg.
44. *L. rufus* (Scop.) Fr.
45. *L. subdulcis* (Bull.) Fr.

46. *L. subtomentosus* B. et Rav.
47. *L. subpurpureus* Pk.
48. *L. theiogalus* (Bull.) Fr.
49. *L. torminosus* (Schæff.) Fr.
50. *L. volemus* Fr.
51. *Russula furcata* (Pers.) Fr.
52. *Cantherellus aurantiacus* Fr.
53. *C. cibarius* Fr.
54. *C. cinereus* Fr.
55. *C. floccosus* Schwein.
56. *C. infundibuliformis* (Scop.) Fr.
57. *C. minor* Pk.
58. *C. princeps* B. et C.
59. *C. wrightii* B. et C.
60. *Marasmius anomalus* Pk.
61. *M. archyropus* (Pers.) Fr.
62. *M. capillaris* Morg.
63. *M. ferrugineus* Berk.
64. *M. melanopus* Morg.
65. *M. plectophyllus* Mont.
66. *M. præacutus* Ellis.
67. *M. rotalis* B. et Br.
68. *M. salignus* Pk.
69. *M. viticola* B. et C.
70. *Lentinus lecomtei* Fr.
71. *L. lepideus* Fr.
72. *L. strigosus* Fr.
73. *Panus stipticus* (Bull.) Fr.
74. *Lenzites betulina* (Linn.) Fr.
75. *L. cookei* Berk.
76. *L. crataegi* Berk.
77. *Pholiota squarrosoides* Pk.
78. *Crepidotus fulvo-tomentosus* Pk.
79. *Paxillus flavidus* Berk.
80. *Agaricus campester* Linn.

FAMILY POLYPORACEÆ.

81. *Boletus americanus* Pk.
82. *B. auriporus* Pk.
83. *B. badius* Fr.
84. *B. castaneus* Bull.
85. *B. chrysenteron* Fr.
86. *B. collinitus* Fr.
87. *B. felleus* Bull.
88. *B. flavidus* Fr.
89. *B. gracilis* Pk.
90. *B. granulatus* Linn.
91. *B. leprosus* Pk.
92. *B. purpureus* Fr.
93. *B. ravenelii* B. et C.
94. *B. retipes* B. et C.
95. *B. speciosus* Frost.
96. *B. subtomentosus* Linn.
97. *B. variegatus* Swartz.
98. *Strobilomyces strobilaceus* (Scop.) Berk.
99. *Boletinus decipiens* (B. et C.) Pk.
100. *Fistulina hepatica* Fr.
101. *Polyporus borealis* (Wahlenb.) Fr.
102. *P. dichrous* Fr.
103. *P. elegans* (Bull.) Fr.
104. *P. elegans* var nummularius (Fr.) Sacc.
105. *P. epileucus* Fr.
106. *P. flavo-virens* B. et Rav.
107. *P. fumosus* (Pers.) Fr.
108. *P. hirsutulus* Schwein.
109. *P. nivosus* Berk.
110. *P. sulphureus* (Bull.) Fr.
111. *Fomes applanatus* (Pers.) Wallr.
112. *F. carneus* Nees.
113. *F. curtisii* Berk.

114. *F. fuliginosus* Fr.
115. *F. salicinus* (Pers.) Fr.
116. *Polystictus abietinus* Fr.
117. *P. circinatus* Fr.
118. *P. decipiens* Schwein.
119. *P. lutescens* Pers.
120. *P. montagnei* Fr.
121. *P. parvulus* Klotzsch.
122. *P. pergamenus* Fr.
123. *P. perennis* (Linn.) Fr.
124. *P. sanguineus* (Linn.) Mey.
125. *P. tomentosus* Fr.
126. *P. versicolor* (Linn.) Fr.
127. *Cyclomyces greenii* Berk.
128. *Favolus canadensis* Klotzsch.
129. *F. tessellatus* Mont.

FAMILY HYDNACEÆ.

130. *Hydnum aurantiacum* Alb. et Schwein.
131. *H. adustum* Schwein.
132. *H. candidum* Schmidt.
133. *H. fragile* Fr.
134. *H. glabrescens* B. et Rav.
135. *H. gracile* Fr.
136. *H. graveolens* Delast.
137. *H. levigatum* Swartz.
138. *H. pulcherrimum* B. et C.
139. *H. repandum* Linn.
140. *H. rufescens* Pers.
141. *H. squamosum* Schæff.
142. *H. zonatum* Batsch.
143. *H. velutinum* Fr.
144. *Tremellodon gelatinosum* (Scop.) Pers.
145. *Radulum pallidum* B. et C.

FAMILY THELEPHOREÆ.

146. *Craterellus cantherellus* Schwein.) Fr.
147. *C. cornucopioides* (Linn.) Pers.
148. *C. odoratus* Schwein.
149. *Thelephora anthocephala* Fr.
150. *T. cæspitulans* Schwein.
151. *T. cladonia* Schwein.
152. *T. dissecta* Lév.
153. *T. schweinitzii* Pk.
154. *T. sebacea* Pers.
155. *T. spectabilis* Lév.
156. *Stereum frustulosum* (Pers.) Fr.
157. *S. spadiceum* Fr.
158. *S. subpileatum* B. et C.
159. *S. versicolor* (Swartz) Fr.
160. *Hymenochæte rubiginosa* (Schr.) Lév.
161. *H. tabacina* (Sow.) Lév.
162. *H. umbrina* B. et C.
163. *Exobasidium rhododendri* Cramer. On leaves of Rhododendron maximum.

FAMILY CLAVARIACEÆ.

164. *Clavaria abietina* Pers.
165. *C. cinerea* Bull.
166. *C. cristata* Pers.
167. *C. flava* Schæff.
168. *C. fusiformis* Sowerb.
169. *C. gracilis* Pers.
170. *C. gracillima* Pk.
171. *C. grisea* Pers.
172. *C. petersii* B. et C.
173. *C. pinophila* Pk.
174. *C. tetragona* Schwein.
175. *Pterula densissima* B. et C.
176. *Typhula muscicola* (Pers.) Fr.

FAMILY TREMELLACEÆ.

177. *Dacryomyces chrysocoma* (Bull.) Tul.
178. *D. involutus* Schwein.
179. *Guepinia spathularia* (Schwein.) Fr.
180. *Hormomyces fragiformis* Cke.

ORDER GASTEROMYCETEÆ.

FAMILY PHALLACEÆ.

181. *Ithyphallus impudicus* (Linn.) Fr.

FAMILY NIDULARIACEÆ.

182. *Cyathus stercoreus* (Schwein.) De Ton.
183. *C. striatus* (Huds.) Hoffm.
184. *Crucibulum vulgare* Tul.

FAMILY LYCOPERDACEÆ.

185. *Mitremyces lutescens* Schwein.
186. *Bovista pila* B. et C.
187. *Lycoperdon calyptriforme* Berk.
188. *L. echinatum* Pk.
189. *L. gemmatum* Batsch.
190. *L. muscorum* Morg.
191. *L. perlatum* (Pers.) Fr.
192. *L. subincarnatum* Pk.
193. *L. turneri* E. et E.
194. *Scleroderma lycoperdoides* Schwein.
195. *S. verrucosum* (Bull.) Pers.
196. *S. vulgare* Hornem.

ORDER UREDINEÆ.

197. *Puccinia circææ* Pers. On Circæa alpina.
198. *P. menthæ* Pers. On Labiate species.
199. *P. tenuis* Burrill. On Eupatorium.

ORDER PHYCOMYCETEÆ

FAMILY PERONOSPORACEÆ.

200. *Plasmopara viticola* (B. et C.) Berl. et De Ton.

ORDER PYRENOMYCETEÆ.

FAMILY PERISPORIACEÆ.

201. *Microsphæra alni* (DC.) Winter. On Castanea vesca and Corylus americana.

202. *M. grossulariæ* (Wallr.) Lév. = *M. vanbruntiana* Ger. On Sambucus canadensis.

203. *M. vaccinii* C. & P. On Vaccinium.

204. *Podosphæra biuncinata* C. & P. On Hamamelis virginica.

205. *P. oxyacanthæ* (DC.) D. By. On Cratægus punctata.

FAMILY SPHÆRIACEÆ.

206. *Hypoxylon petersii* B. & C.

207. *Daldinia vernicosa* (Schwein.) Ces. et D. Not.

208. *Xylaria carniformis* Fr.

209. *X. cornu-damæ* (Schwein.) Berk.

210. *Ustulina vulgaris* Tul.

FAMILY HYPOCREACEÆ.

211. *Cordyceps militaris* (L.) Link.

212. *C. ophioglossoides* (Ehr.) Link.

213. *Hypomyces banningii* Pk. On Lactarius.

214. *H. lactifluorum* (Schwein.) Tul. On Lactarius piperatus.

215. *H. viridis* (Alb. et Schwein.) Karst. On undetermined agaric.

ORDER DISCOMYCETEÆ.

FAMILY HELVELLEÆ.

216. *Helvella macropus* (Pers.) Karst.

217. *Mitrula lutescens* B. et C.

218. *Geoglossum hirsutum* Pers.
219. *G. Walteri* Berk.
220. *Spathularia velutipes* Cke. et Farlow.

FAMILY PEZIZEÆ.

221. *Geopyxis pallidula* C. et Pk.
222. *Otidea onotica* (Pers.) Fuck.
223. *Lachnea cubensis* B. et C.
224. *L. fusicarpa* Ger.
225. *L. hirta* Schum.
226. *L. theleboloides* Alb. et Schwein.
227. *Helotium citrinum* (Hedw.) Fr.
228. *H. epiphyllum* (Pers.) Fr.
229. *Phialea scutula* (Pers.) Gill.
230. *Chlorosplenium æruginosum* (Œder.) De Not.
231. *C. tortum* (Schwein.) Fr.
232. *Phæopiza scabrosa* (Cke.) Sacc.

FAMILY BULGARIEÆ.

233. *Leotia chlorocephala* Schwein.
234. *L. lubricata* (Scop.) Pers.
235. *Ombrophila clavus* (Alb. et Schwein.) Cke.
236. *Calloria xanthostigma* (Fr.) Phill.
237. *Bulgaria inquinans* (Pers.) Fr.

ORDER MYXOMYCETEÆ.

238. *Arcyria punicea* Pers.
239. *Didymium farinaceum* Schrad.
240. *D. squamulosum* (Alb. et Schwein.) Fr.
241. *Fuligo septica* (Link) Gmel.
242. *Hemiarcyria varneyi* Rex.
243. *Lycogala fragilis* (Dicks.) Rost.
244. *Stemonitis ferruginea* Ehrh.
245. *S. maxima* Schwein.
246. *Tilmadoche nutans* (Pers.) Rost.
247. *Trichia chrysosperma* (Bull.) DC.

ORDER HYPHOMYCETEÆ.

248. *Isaria farinosa* Fr.
249. *I. tenuipes* Pk.
250. *Zygodesmus fuscus* Corda.

ORDER SPHÆROPSIDEÆ.

251. *Phyllosticta violæ* Desm.

ORDER MELANCONINEÆ.

252 *Pestolozzia funerea* var *multiseta* Desm.

ORDER SACCHAROMYCETACEÆ.

253. *Saccharomyces pyriformis* Ward.

ORDER SCHIZOMYCETACEÆ.

254. *Bacterium vermiforme* Ward.

BOTANICAL DEPARTMENT, CORNELL UNIVERSITY.
March 12, 1893.

RECORD OF MEETINGS.

SEVENTIETH MEETING.

GERRARD HALL, September 13, 1892.

Southern Industrial Progress. Dr. William B. Phillips.

SEVENTY-FIRST MEETING.

PERSON HALL, October 18, 1892.

10. The Work of Science. Charles Baskerville.
11. Early Manufacture of Iron in North Carolina. H. B. C. Nitze.
12. Encystment of Earth-worms. H. V. Wilson.
13. Experiments on Halving Eggs. H. V. Wilson.
14. Effect of the Earth's Rotation on the Deflection of Streams. Collier Cobb.
15. Note on Traps and Sandstone in the Neighborhood of Chapel Hill. Collier Cobb.

SEVENTY-SECOND MEETING.

PERSON HALL, November 15, 1892.

16. A New Secondary Cell. J. W. Gore.

17. Some Curious Products from the Willson Aluminum Works. F. P. Venable.

18. On the Production of an Animal Without Any Maternal Characteristics. H. V. Wilson.

SEVENTY-THIRD MEETING.

PERSON HALL, December 6, 1892.

19. Work of the N. C. Geological Survey. J. A. Holmes.

20. Cerebral Localization. R. H. Whitehead.

The following officers were elected for 1893:

President	PROF. J. A. HOLMES	Chapel Hill.
First Vice-President	PROF. H. L. SMITH	Davidson.
Second Vice-President	PROF. J. W. GORE	Chapel Hill.
Librarian	PROF. COLLIER COBB	Chapel Hill.
Secretary and Treasurer	PROF. F. P. VENABLE	Chapel Hill.

The Secretary reported 1,170 books and pamphlets received during the year, making the total number 9,948.

Two new members were also reported: Prof. Stedman, Trinity College; Prof. Bandy, Trinity College.

REPORT OF TREASURER FOR 1892.

By balance from 1891	$ 40 02	
By fees for 1892	64 50	
By contributions	100 00	
By sales of Journals	1 50	
	$206 02	
To postage		$ 15 65
To engraving		10 82
To express		2 75
To printing		193 00
		$222 22
Deficit		$ 15 80